

Subject Area 5.1: Microbial studies and technologies supporting waste disposal, management, and remediation of municipal and industrial hazardous wastes

Research Article

Feasibility Assessment of Electrocoagulation Towards a New Sustainable Wastewater Treatment*

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Abstract

Background, Aim and Scope. Electrocoagulation (EC) may be a potential answer to environmental problems dealing with waste water and critical waste management. The aim of this research was to assess the feasibility of EC process for industrial wastewater effluents from copper production, taking into consideration technical and economic factors. EC technology claims to offer a novel method of waste water treatment with low energy consumption and without adding any precipitating agents.

Methods and Methods. Real wastewater from local waste water high concentration of heavy metals was provided by RTH 3000.

A 1000 copper plating and anodizing complex, that was previously used as a 10 l EC-reactor using aluminum plates as sacrificial electrodes and powered by a 60 V supply unit. Results concerning low factors like pH, conductivity and power consumption were measured in real time. Analysis of dissolved metal concentrations before and after treatment were carried out via ICP-OES and confirmed by an independent test via IAA.

Results. Several aspects were taken into account, including cost, conductivity, metalization capacity and reactive settings throughout the run, in order to analyze all possible factors that may be a restriction and metal removal in real industrial wastewater.

Discussion. Electrode configurations and their effects on energy demand were discussed and exemplified based on fundamentals of colloidal and physical chemistry.

Conclusions. Based on experimental data and since no precipitating agents were applied, the EC process proved to be an only feasible and environmentally friendly, but also a cost-effective technology.

Recommendations and Perspectives. The EC technology provides enough guidelines for further research and development of sustainable waste management processes. However, additional experiments concerning continuous operation must be still performed in order to gain design ready for future large-scale applications.

Keywords: Aquatic chemistry, electrocoagulation, energy demand, metal removal, sustainability, wastewater treatment

Introduction

Despite the fact that electrocoagulation (EC) technology was patented a century ago [1], the absence of any significant innovation concerning this technology is quite disappointing. Given the world water crisis forecasted by UNO and the World Water Council, there are reasons to believe that by 2020, 17% more water than is readily available will be required in order to feed the world [2]. Therefore, the urgent need for sustainable solutions is recognized. While EC systems provide environmental friendly and cost-effective results for sustainable water reuse, it is disconcerting to realize how many places in the world still remain using freshwater for cleaning purposes.

Furthermore, using renewable energies to operate EC processes would avoid any concern related to global warming due to the electrical power from fossil resources. Since metallurgical wastewater treatment is one key aspect involving heavy metals, the research in EC technology carried out over the last years at IME provides an improvement to future attempts in the field. The drawbacks and opportunities of EC method were technically and economically assessed, including the neutralization and removal of heavy metals within current discharge requirements as stipulated by law.

1. State of the Art

1.1 Generalities

The operating principle behind electrocoagulation involves colloidal chemistry concepts, dealing with the formation, characterization and modification of colloid. These particular structures with singular properties, with sizes within the 1 nm to 1 μ m range, are considered big enough to disturb gravimetric mechanical effects, but concerning largely the thermodynamical properties of the bulk [3]. The passage of dispersed colloidal particles through typical membrane filters is much more restricted than the passage of dissolved ions or molecules which get absorbed by means of surface bound OH-groups and then it becomes easier to separate them from a solution.

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